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Wildlife harvesting from the Afaka Forest Reserve, Kaduna, Nigeria: The prosperity–posterity crossroad

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ABSTRACT

This study examined the harvesting of wildlife from the Afaka Forest Reserve from the standpoint of economic benefits and sustainability. The data for this study were collected using questionnaire and interview in 2017 from eight communities around the Afaka Forest Reserve, Kaduna State, Nigeria. A multi-stage sampling approach was adopted to collect data from 134 respondents who harvest wildlife from the Reserve. Data were analyzed using descriptive statistics, gross margin analysis, and Gini Index analysis. The findings revealed that wildlife incomes from animals like rabbits, porcupines, bats, and monitor lizards contributed 18.41% of total incomes of communities living around the Afaka Forest Reserve in Kaduna State in 2015. Sixty-one percent of the respondents harvested wildlife at least once in a week. Gross margin was highest in porcupine harvesting (₦26, 872.73) while the highest return per Naira invested (₦8.02) accrued to harvesting of insects. The average gross margin was ₦10, 610.86 while average return on investment was ₦2.35. Wildlife income had a reducing effect on income inequality as the marginal effect of wildlife income on Gini index of total income was -0.0883 meaning a 10% increase in wildlife incomes reduces inequality by about 0.9%. The study recommends that wildlife harvesting regulations which curb indiscriminate harvesting should be enforced alongside continuous sensitization of communities on the importance of sustainable harvesting practices towards a balanced prosperity-posterity equation.

Keywords: Wildlife; income; prosperity; posterity; biodiversity

INTRODUCTION

The forest ecosystem is a rich source of biodiversity. In its natural setting, it is a self-evolving and self-balancing complex and highly dynamic matrix of interdependence between its biotic and abiotic constituents. Forests are at the heart of the 2030 Sustainable Development Agenda. They are multi-sectoral and multi-functional and diverse in their services. They are a source of food, medicines and biofuel for more than 1 billion people.

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Forests provide timber, ecosystem services of water, soil, carbon, cultural values, recreational, medicinal and human health benefits, maintain ecological balance, host more than three quarters of the world's terrestrial biodiversity, and livelihood and income for tens of millions of people (FAO, 2020; Lele *et al*., 2013; Shamaki, 2022; USAID, 2008; UNEP, 2007).

The global total forest area is 4.06 billion hectares, which is 31% of the total land area. The African continent has 21.3% (637million ha) of its total land area as forest while Nigeria's forest cover is about 7million hectares which is about 8 percent of its total land area of 91.077million hectares (FAO, 2020).This total is made up of about 497 gazetted reserves, distributed over the six main ecological zones of fresh water/mangrove, the lowland rainforest, the derived savanna, the Sahel, and Sudan savanna. More than 5 percent of the total land area is devoted to wildlife conservation also distributed across the major ecological zones (Zaman, 2018; FGN, 2015; FAO, 2010).

Biodiversity as provided in the forest must be preserved in order to sustain the multi-faceted benefits accruable from the forests. Conservation is therefore ingrained in the concept of sustainability. Genuine conservation can occur only when human beings consciously use natural resources below their maximum sustainable rates or forego the use of those resources altogether whose existence is threatened. Conservation has benefits for humans but requires restraint and has attendant costs if long term benefits are to be sustained. Therefore, conservation that involves neither restraint nor cost is not really conservation (Dyke, 2008). Indeed, any prosperity that is only situated in the present well-being is an antithesis of posterity, and inimical to sustainable development.

Wildlife is an important component of forest biodiversity which constitutes a greater part of non-timber forest products (NTFPs) which if properly managed can provide good sources of animal protein and income to the immediate communities as well as promote tourism (Anamayi *et al*., 2010). The growth of countries especially as witnessed by the fast pace in developing countries within the last few decades has exerted an enormous and growing pressure on natural resources with widespread and persistent consequences on forest outcomes, and their contribution to economic growth, equity and environmental sustainability (CBD, 2020; Lele *et al*., 2013).

Therefore, humanity stands at crossroads regarding the declining state of global biodiversity *viz a viz* the legacy which is expected to be bequeathed to future generations. In Nigeria, the threat to loss of biodiversity in the forest biomes is not merely hinged on uncontrolled wildlife harvesting but also on the increasing decline in the forest cover due to unsustainable harvesting of timber and fuel wood and invariably loss of wildlife habitat (NCF, 2023). This is the burden of this of critique within the context of the harvesting of wildlife from the Afaka Forest Reserve in Kaduna State, Nigeria.

Humans are the major source of distortions in ecological balance and biodiversity which has emanated from the failure to have value and offer long and sustainable stewardship over the environment. Biodiversity in Nigeria, as is the case in many countries is largely considered a 'common good' (FGN, 2015). It is therefore largely affected with the principle of the tragedy of the commons which is characteristic with the use of common pool resources which tend to be over-used, or over-exploited, because no one person or institution has exclusive private rights to use the resource. Hence, a survival of the fittest attitude in exploitation of natural resources (and in this case wildlife) which is on the long-run unsustainable becomes the order of the day, so that existential necessities of the present become annihilative and existential threats for posterity.

Hence, a balance in present use or harvesting of wildlife resources for today's well-being and prosperity must be moderated by the need for continuous provisioning for the future or posterity who will also depend on the preserved wildlife and other natural resource as legacies. This is consistent with the "environmental impact triangle" (Figure 1) displaying three key elements of human environmental impact on nature: the interaction of the characteristics of the local natural environment (nature), the kind of local human economy employed by the human community, and the perceptions of and attitudes toward nature by humans.

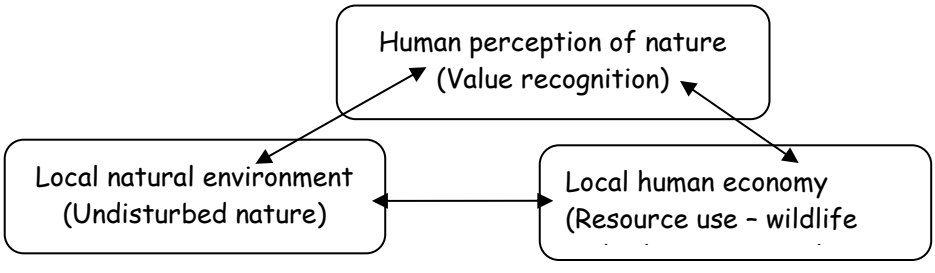

Figure 1: Man in the environmental impact triangle
Source: Adopted from Dykes (2008)

Only when human perception begins to view nature as something of value in itself, or something to be sustained beyond immediate need for future generations, does conservation emerge as a consistent practice in the human community and thrives on the tripod economic, social and environmentally sustainable development. Man, therefore, is the architect of designing and sustaining the balance for his prosperity and posterity.

METHODOLOGY

Study Area

Afaka Forest Reserve was established in 1954 as an experimental plantation site by the Japan International Cooperation Agency (JICA) in conjunction with the then British colonial authorities in Nigeria with the primary aim of curtailing the imminent deterioration and loss of the semi – arid environment of the Northern – Guinea Savannah of Nigeria to the threat of desertification. Afaka Forest Reserve occupies an area of about 7,093.12 hectares of land and lies between Latitudes 10° $36^{'}$ $18^{'}$ and 10° $37^{'}$ $48^{'}$ N, and Longitudes 7° $14^{'}$ $34^{'}$ and 7° $21^{'}$ $58^{'}$ E (Zaman, 2018; Otiwa, 2015; Yahaya, 2015; JICA, 1991).

The Afaka Forest Reserve is located within the transition belt, between the far south forest belt and the savanna woodlands in northern Nigeria, where there is a large band of derived savanna, which has undergone large-scale anthropogenic modifications. Beyond the northern frontiers of the Reserve, the conditions are drier, characterized by a sparse vegetation that is woody with thorny trees mixed with deciduous and semi-deciduous woodlands, with characteristic baobabs (*Adansonia digitata*) further north in the Sudan savanna. The savanna habitats also support a wide range of wildlife such as antelopes, elephants, pythons, and lions, *Funisciurus sp* (tree squirrel), *Manis tricupsis* (pangolin), *Artherurus africana* (porcupines), *Dendohyrax dorsalis* (tree hyrax), *Thryonomys*

swinderianus (grasscutter), *Cricelomys gambianus* (giant rat), *Varannus niloticus* (monitor lizard), *Tragelapus sciptus* (antelope), and rabbits (Ochi & Zaman, 2022; Zaman, 2018).

Data Collection and Analysis

Structured questionnaire and interview methods were used to collect data from the study area in 2017. Multi-stage sampling technique was used for data collection. First, thirteen communities were purposively selected because of their contiguity to the Reserve. Then, eight communities out of these (13) were randomly selected as follows: Rigasa, Mando (Sabon-Afaka), Likora, Gwazaye, Hayin Dan-mani (all in Igabi Local Government Area) and Udawa, Buruku and Kuriga (in Chikun Local Government Area). Lastly, a total 134 respondents were proportionally and randomly sampled from the eight communities for this study.

The questionnaire was structured into three sections. The first section covered socio-economic characteristics (such as gender, years of experience in wildlife harvesting, educational level, household size, and occupation). The second section dwelt on wildlife harvesting types and practices. The third section sought for information household income sources.

Data were analyzed using descriptive statistics, gross margin, and Gini index analysis. Charts and percentages were used for descriptive purposes.

Gross margin represents the difference between the total value of production or total income and the variable cost of production (John *et al*., 2013). This analysis was used in this study to analyze the profitability of wildlife harvesting by the respondents.

The gross margin is given by:

$$GM = GI - TVC \quad \ldots (1)$$

Where; GM = Gross margin

GI= Gross income ($QWL_i * PWL_i$)

Where; QWL_i = quantity of the i^{th} wildlife collected
PWL_i = unit price of the i^{th} wildlife collected
TVC= Total variable cost.

The return for each Naira (₦) invested in wildlife harvesting (which covered costs like transportation, gun powder, and processing costs) was also determined in line with the work of Amaza *et al*. (2007) as given by:

$$\text{Return on Investment (ROI)} = GM/TVC \quad \ldots (2)$$

The Gini coefficient was used to estimate the effects of wildlife harvesting income on income inequality. Wildlife income was considered alongside other income sources of the respondents (which were farming, crafts, trading, salaries, and pension).

The effect of wildlife income on inequality was analyzed using the Gini coefficient model proposed by Lerman and Yitzhaki (1985) and adopted by Fonta and Ayuk (2013), and Idoko and Ikpeze (2014) was used in this study. It is given as:

$$G_k = 2\frac{COV[Y_k k, F(Y_k)]}{\mu_k} \quad \ldots \quad (3)$$

Where; G_k = the income of the household (i.e. wildlife and other income sources)

F (Y_k) = the cumulative distribution of income source k, and

μ_K = mean household income.

Similarly, assume G_T as the Gini coefficient of total income, then the Gini coefficient (G_T) of total household income is given by:

$$G_T = 2\sum_{k=1}^{k} COV[Y_k, F(Y_k)]/\mu_T \quad \ldots (4)$$

This also equates:

$$G_T = \sum_{k=1}^{k} S_k G_k R_k \quad \ldots (5)$$

Where S_k, represents the share of household income k on total income, G_k measures the Gini coefficient of each income source k, while R_k measures the Gini correlation between income source k and the distribution of total income.

STATA (version 13) statistical software was used for the analysis.

RESULTS AND DISCUSSION

Distribution of Respondents according to Primary Occupation

The livelihood and welfare of a community or society is largely a function of the economic activities of its people in terms of their occupations (Zaman, 2018). Fourty two percent of the respondents in the study area were farmers (Figure 2), which was comparatively lower than the value (57%) for North-west geographical region in 2013 as reported by the World Bank (2016d). The hunters constituted least proportion (1.49%) of the respondents meaning that the wildlife collection in the area was ironically dominated by non-hunters.

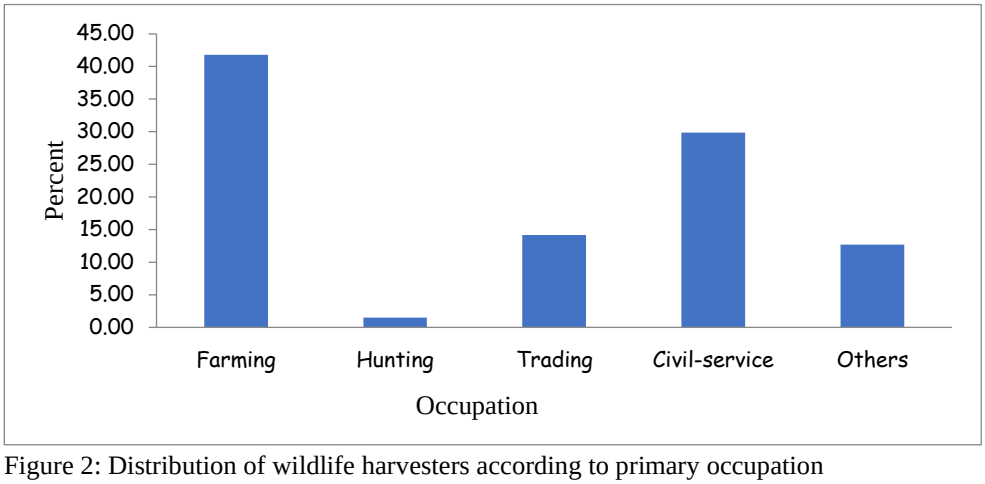

Figure 2: Distribution of wildlife harvesters according to primary occupation

Wildlife Harvesting Frequency

The study revealed that the highest frequency of harvesting was 1-2 times weekly (30%) and cumulatively, 69% of respondents harvest wildlife from the reserve at least once

a week. Although there is no inventory of the animals in the Afaka Forest Reserve, the frequency of unregulated harvesting is a determinant of the rate of wildlife depopulation and loss of biodiversity (Ticktin, 2004; Freckleton *et al.*, 2003).

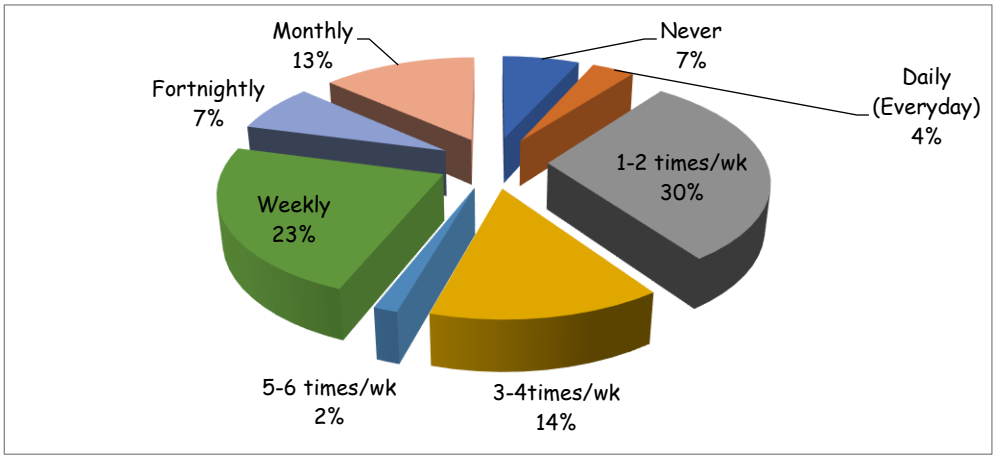

Figure 3: Frequency (%) of wildlife harvesting

Volume of Wildlife Harvested

Bats were the most harvested animals (1021) from the Reserve (Figure 4) while the least was the python (5). It is established that harvest rates which exceed the replacement capacity of species eventually lead to species loss (NCF, 2023; Dyke, 2008). This is most crucial for wildlife species which have been listed as endangered or threatened species.

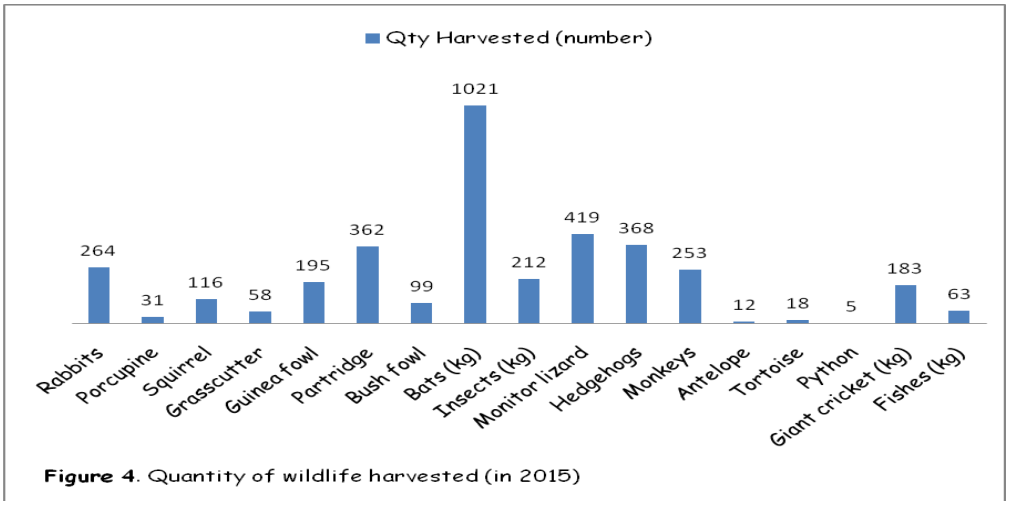

Figure 4: Quantity of wildlife harvested

Gross Margin Analysis of Wildlife Harvesting

Gross margin analysis is usually applied to profitability analysis when the fixed cost of production constitutes a negligible component of the enterprise. It is the difference between the total value or income of production and the variable cost of production (Maruod *et al*., 2014; John *et al*., 2013). The variable cost component in the harvesting of wildlife considered were transportation, cost of gun powder, and labour. The gross margin analysis was applied in this study to assess how the sales and invariably incomes from wildlife contribute to the welfare and prosperity of forest dependent populations. The gross margin (GM) analysis (Table 1) showed that porcupines provided the highest income (₦26, 872.73) even though it was the third least harvested as shown on Figure 4. The return on investment (ROI) was however highest for insects (₦8.02). Although, both average GM (₦10,610.86**)** and ROI (N2.35) seemed favourable, these indices did not account for the imputed cost of each animal harvested as well as the attendant ecosystem and biodiversity losses, meaning that the gains as incomes were in the short run.

Table 1: Gross margin analysis of wildlife harvesters

Wildlife Type	Gross Income (₦)	Total Variable Cost (₦)	Gross margin/profit (₦)	Return on Investment (₦)
Rabbit	14,064.00	9,057.20	5,006.80	0.55
Porcupine	43,145.45	16,272.73	26.872.73	1.65
Squirrel	12,350.00	5,006.25	7,343.75	1.47
Grasscutter	10,860.00	2,700.00	8,160.00	3.02
Guinea fowl	25,377.78	14,770.37	10,607.41	0.72
Partridge	14,018.18	5,250.00	8,768.18	1.67
Bush fowl	57,845.00	21,560.00	36,285.00	1.68
Bats	9,066.67	4,300.00	4,766.67	1.11
Monitor lizard	16,860.50	7,600.00	9,260.50	1.22
Hedgehog	4,855.25	1,600.00	3,255.25	2.03
Monkey	15,650.00	4,800.00	10,850.00	2.26
Antelope	12,600.00	2,750.00	9,850.00	3.58
Tortoise	3,150.00	700.00	2,450.00	3.50
Python	32,640.00	11,550.00	21,090.00	1.83
Giant cricket	2,150.00	600.00	1,550.00	2.58
Insects	3,473.33	385.00	3,088.33	8.02
Fishes	14,880.00	3,700.00	3,700.00	3.02
Total	292,986.16	112,601.55	180,384.62	39.92
Average	17,234.48	6,623.62	10,610.86	2.35

Distributional Effects of Wildlife Harvesting Income

Gini analysis of income is achieved by decomposing income sources so as to provide a picture of how prosperity is shared or how total inequality is concentrated in specific income sources or not. It provides a clear idea on how each component contributes to the total inequality. The Gini index measures the extent to which the distribution of income among individual households within communities deviates from a perfectly equal distribution (Ochi &Zaman, 2022; Araar, 2006; Lorenzo and Liberati, 2006). It is important

to note that the lower the Gini index, the lower the level of inequality meaning a better shared prosperity.

Results in Table 2 indicate that the share of wildlife income in total income was 18.41% with a Gini coefficient of 0.3426 which was higher than the overall Gini index of 0.2384. The contribution of the incomes from wildlife to reducing income inequality was evident from the negative value of its marginal effect (MEF_G), -0.0888 implying that there is a decrease of 8.83% decrease in income inequality for every 10% increase in wildlife harvesting incomes.

Table 2: Distribution of income inequality according to income sources

Income Source	Income Share (S_k)	Gini Correlation (R_k)	Gini Coefficient (G_k)	Absolute Contribution ($S_k*R_k*G_k$)	Relative Contribution ($S_k*R_k*G_k$)/G	MEF_G ($S_k*R_k*G_k$)/G - S_k
Wildlife	0.1841	0.3620	0.3426	0.0228	0.0956	-0.0883
Farming	0.0381	0.6229	0.4328	0.0103	0.0431	0.0050
Crafts	0.1167	0.2577	0.8608	0.0259	0.1086	-0.0081
Trade	0.0755	0.0184	0.8686	0.0012	0.0051	-0.0704
Salaries	0.3817	0.4753	0.6762	0.1227	0.5146	0.1329
Pension	0.2039	0.3227	0.8441	0.0555	0.2330	0.0291
Total	1.0000	-	-	0.2384	1.0000	

*MEF_G – Marginal effect on Gini index of total income.

CONCLUSION

This study revealed that the economic indices (gross margin. return on investment and Gini indices) of wildlife incomes on the prosperity of Afaka forest communities were all satisfactory in the short run. But therein lays the pitfalls for posterity in the absence of adequate knowledge of the essence of sustainable harvesting of wildlife resources by the community beneficiaries. Although the National Parks are a major repository of much of Nigeria's protected wildlife biodiversity, the Forest Reserves are also important enclaves for the conservation of wildlife. Therefore, the study recommended that there is need for continuous sensitization of people in forest communities on the need for sustainable harvest of wildlife whether for consumption or as a source of income. The policy and institutional framework for sustainable conservation should also be repositioned for a win-win in the prosperity-posterity equation of not just the people around the Afaka Forest Reserve, but also relevant for several forest-dependent economies.

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